Grant-in-Aid for Scientific Research (Chemical Research Grant)
Research Result Report

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Research line: Fundamental research (C)
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Research title : A study of anti-bacterial effect of low-concentration chlorine dioxide gas against airborne causative bacteria of nosocomial infection.

Research representative
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Summary of research results (English):
We assessed the antimicrobial effect of low-concentration chlorine dioxide(ClO2) gas against air bone bacteria in an indoor environment (a medical office of Showa university (66.5 ㎥, live space)). Firstly, we calculated the number of air bone bacteria using air sampler in a medical office (control) (temperature and humidity was not controlled.). And then, safe low-concentration ClO2 gas was generated in the medical office. Coming in and out at the door were not restricted. The concentration of ClO2 gas was stable at 0.01ppm-0.02ppm approximately. When low-concentration ClO2 gas was generated in a room, indoor air bone bacteria were reduced compared with the control level. This antimicrobial effect of low concentration ClO2 gas was continued during the period that ClO2 gas was generated. Low concentration ClO2 gas is effective for reducing the number of air bone bacteria in a live space.

Research field: Medical and dental pharmacy
Grants-in-Aid for Scientific Research: Internal Medicine Clinical Medicine / Infectious Diseases
Key words: Post-hospital infection, chlorine dioxide gas, real-time bacteria count, microbial inactivation effect

1 Background at the beginning of R & D

Nosocomial infections are widespread among patients and health care workers and occasionally die. Methicillin-resistant Staphylococcus aureus (MRSA) and norovirus are typical pathogens of nosocomial infections, and infection countermeasures are necessary. The main route of infection of these pathogens is contact infection, but airborne infection cannot be ignored. HEPA filters are frequently used to combat pathogenic microorganisms floating in the air, but there are expectations for drugs that exhibit microbial effects that are safe and effective for combating airborne infections.

2 Purpose of research

By generating low-concentration chlorine dioxide gas indoors, it is considered that a non-specific microbial inactivation effect can be obtained regardless of the target microbial species. The purpose of this study is to examine the antimicrobial effect of low-concentration chlorine dioxide gas in manned rooms.

3 Research methods

Measurement of ClO2 gas release and concentration, measurement of suspended bacteria concentration

An air sampler was installed near the center of the Department of Clinical Infectious Diseases of Showa University School of Medicine (66.5 mm, natural ventilation) to measure the number of airborne bacteria. A standard agar medium was attached to the air sampler, and the room air was collided at 100 l / min for 10 minutes (1 kg) to collect the bacteria, which were then subjected to a culture test. Airborne bacteria were measured at least 6 times a day for a total of 18 times for 3 consecutive days. Before installing the ClO2 gas generator, the number of airborne bacteria was measured for 3 consecutive days to obtain the Control group. Next, a ClO2 gas generator was installed on the side wall surface of the medical office, and ClO2 gas was continuously generated at 10 mg / h. At the same time, the ClO2 gas

concentration was measured with a ClO2 gas sensor. In the same way as the control group, we measured the number of suspended bacteria on the 3rd day from the ClO2 gas generation day (1-3days), from the 14th day to the 16th day (14-16days), from the 28th day to the 30th day (28-30days). The medical office temperature and relative humidity during the study period were 23.0 ° C ± 1.9 ° C and 35.5 ± 5.9%, respectively, in general room conditions.

4 Research results

Before operating the ClO2 gas generator, the concentration of airborne bacteria for 3 days was measured 6 times a day as a Control group. The concentration of airborne bacteria per one measurement was 148.6 ± 36.2 CFU / ㎥ (mean value ± SE, n = 18). At that time, the ClO2 gas concentration was 0 ppm. The average ClO2 concentration for 3 days (1-3days) after the start of ClO2 gas generator operation is 0.021ppmv ± 0.009ppmv (mean ± SD, n = 18), and the concentration of airborne bacteria is 58.1CFU / ㎥ ± 6.3CFU / ㎥ (The average value decreased to ± SE, n = 18). Furthermore, the ClO2 gas concentration for the three days (14-16days) from 14th to 16th after the start of ClO2 gas generator operation is 0.015ppmv ± 0.004ppmv (average value ± SD, n = 21), and the floating bacteria concentration is 41.7 ± 4.8. CFU / ㎥ (mean ± SE, n = 21) was significantly lower than Control ($p < 0.05$). The ClO2 gas concentration is 0.011ppmv ± 0.004ppmv (average value ± SD, n = 18) for 3 days (28-30days) from 28th to 30th after the ClO2 gas generator starts operation, and the floating bacteria concentration is 40.4 CFU / ㎥ At ± 7.1 CFU / ㎥ (mean value ± SE, n = 18), the concentration of planktonic bacteria decreased significantly ($p < 0.01$) compared to Control. As a result of simple identification of airborne bacterial species, 4 gram-positive cocci, 3 gram-positive bacilli and 6 gram-negative bacilli were isolated. As representative bacterial species, Coagulase-negative Staphylococci, Micrococcus sp., Corynebacterium sp., Enterococcus sp. Appeared, and a decreasing tendency was observed in the ClO2 gas acting group as compared with each Control group. In particular, Coagulase-negative Staphylococci and Enterococcus sp. were significantly reduced in 14-16 days and all ClO2 action groups, respectively.

From the above results, by generating ClO2 gas of 0.01ppmv to 0.02ppmv (average ± SD: 0.0154ppmv ± 0.007ppmv) in the medical office, the concentration of airborne bacteria in the medical office tends to decrease immediately after the occurrence, After 2 weeks of occurrence, it decreased significantly and continuously. Coagulase-negative Staphylococci and Enterococcus sp. were significantly reduced in bacterial

species.
This result is considered to suggest that low-concentration chlorine dioxide gas may have a preventive effect on the onset of infections caused by airborne bacteria in the hospital.

5 Main papers

(Underline to research representatives, research leaders and collaborators)

[Journal Articles] (0 in total)

I submitted to J Infection and Chemotherapy, but because it was rejected, I am currently considering posting to another magazine.

[Conference presentations] (0 in total)

[Books] (Total 0)

[Industrial property rights]

Application status (total 0)

Name:
Inventor:
Right holder:
Type:
Number:
Application date:
Domestic and foreign:

Acquisition status (total 0)

Name:
Inventor:
Right holder:
Type:
Number:
Application date:
Domestic and foreign:

[Others]

Homepage etc.

None

6 Research organization

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(2010 → 2011: Researcher)

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Researcher number: